## 9600 BPS Data Modem Module

Description

Xecom's XE9601 provides high-speed data transfer in a compact component. The XE9601 is a complete modem not just a modem chip. It includes the telephone interface and all required RAM and ROM. The XE9601's internal telephone interface permits Xecom to offer user transferable FCC Part 68 registration on the XE9601. The XE9601 connects to the host through a TTL level serial interface and to the telephone network through a user-supplied RJ11 jack.

Xecom's XE9601, XE1401, XE3301 and XE2401 share a common pin configuration. This permits Xecom customers to select the appropriate data rate from 2400 to 33,600 bps.

Features

- Small Size; 2.75 " x 1.38" x 0.55"

- Modem Protocols: CCITT V.32, V.22bis, V.22, V.21; Bell 212A and 103

- Pin compatible with Xecom's XE2401

- User Transferrable FCC Part 68 Registration

- Modem control with "AT" commands

- Modem link speed to 9600 bps

- Low power, single +5V supply
  Operating Power 1.0 W (Typ.)
 Idle Power 125 mW (Typ.)
  Sleep mode: 50 mW (Typ.)

Block Diagram
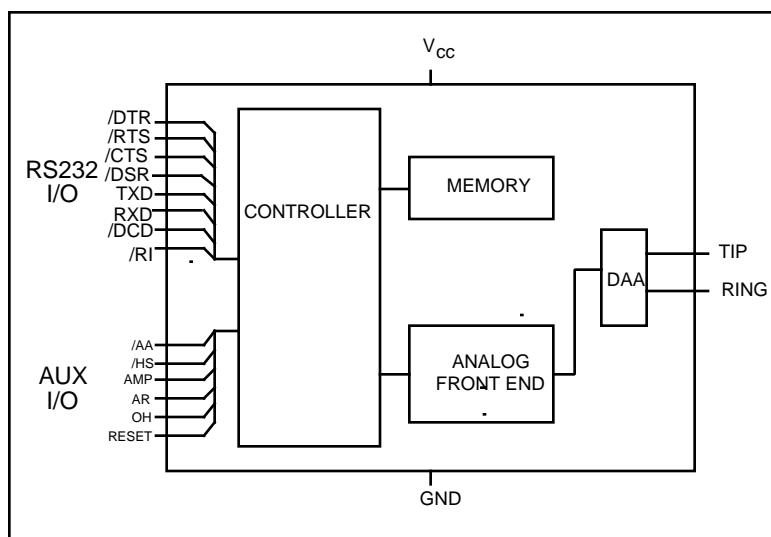
PIN CONFIGURATION

Mechanical Specifications - XE9601

PIN	INCHES		METRIC(MM)	
	MIN	MAX	MIN	MAX
A	2.74	2.760	69.60	70.10
B	1.370	1.390	34.80	35.31
C	0.490	0.510	12.45	12.95
D	0.890	0.910	22.61	23.11
E	1.890	1.910	48.01	48.51
F	0.175	0.250	4.41	6.35
G	0.080	0.100	2.03	2.54
H	0.415	0.435	10.54	11.05
J	0.090	0.110	2.29	2.79
K	0.020	0.040	0.51	1.02
L	0.380	0.400	9.65	10.16

Pins = 0.025 inch square pin
All pins tin-plated

Denotes Pin 1
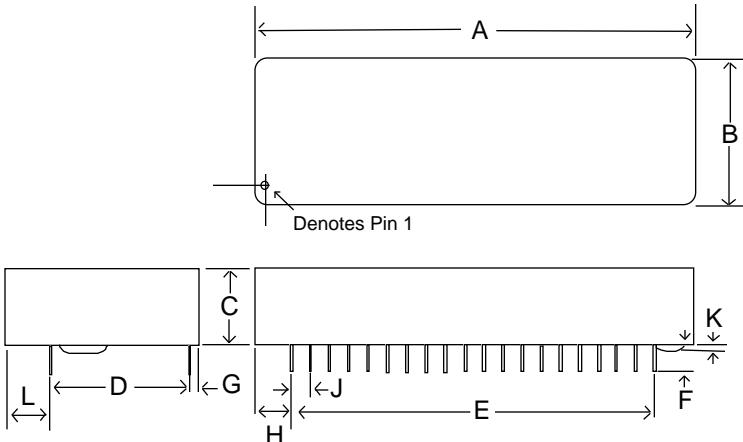
Pin Descriptions

PIN	NAME	I/O	DESCRIPTION
1	RESET	I	Hardware reset pin, Input, active High, TTL. A high on Pin 1 initiates a hardware reset. An external reset is not required or recommended. The Reset pulse must be a minimum of 200 milliseconds long.
2	N/C		No Connection
3	RXD	O	Received Data, Output, TTL. Serial data output to the host. A logic "high" represents a "mark" and a logic "low" represents a "space".
9	\DTR	I	Data Terminal Ready, Input, active Low, TTL. "&D" sets the function of DTR. The default, &D2, requires the host to assert DTR to permit a modem link. The modem drops the call in progress if DTR is revoked and will not connect until DTR is reasserted.
10	\AA	O	Auto-Answer, Output, active Low, TTL. A low on \AA indicates the modem is configured to automatically answer an incoming call.
11	\CTS	O	Clear to Send, Output, active LO, TTL/CMOS. This pin indicates the modem is able to transfer data.
12	OH	O	Off-Hook, Output, active High. OH indicates the modem's hookswitch relay is closed. Hookswitch closure connects the modem to the telephone line.
13	TXD	I	Transmit Data, Input, TTL. Serial data input from the host. A logic "high" represents a "mark" and a low represents a"space", TTL.
14	\RTS	I	Request to Send, input, active LO, TTL. The XE9601 does not use RTS.
15	NC	---	No Internal Connection
16	\RI	O	Ring Indicator, Output, active LO, TTL. When low indicates the modem is receiving a ring signal.
18	TIP	—	Tip connection to the phone line(RJ11 pin3) from the internal DAA. The XE9601 is not sensitive to the battery voltage polarity across Tip and Ring.
20	RING	—	Ring connection to the phone line(RJ11 pin4) from the internal DAA.

Pin Descriptions (continued)

PIN	NAME	I/O	DESCRIPTION
21	GND	—	Ground (0 volts)
22	AMP	O	Audio output function is set by L & M commands and the value in register S22. This output can drive a minimum load of 300 ohms.
38	\DCD	O	Data Carrier Detect, output, active LO, TTL/CMOS. &C sets the DCD function. In the default condition, AT&C1, DCD indicates the presense of a carrier signal on the telephone line.
39	\DSR	O	Data Set Ready, output, active LO, TTL/CMOS. &S sets the DSR function. In the default condition, AT&S0, DSR is forced true.
40	Vcc	—	+5 Volts

Modem Applications Schematic
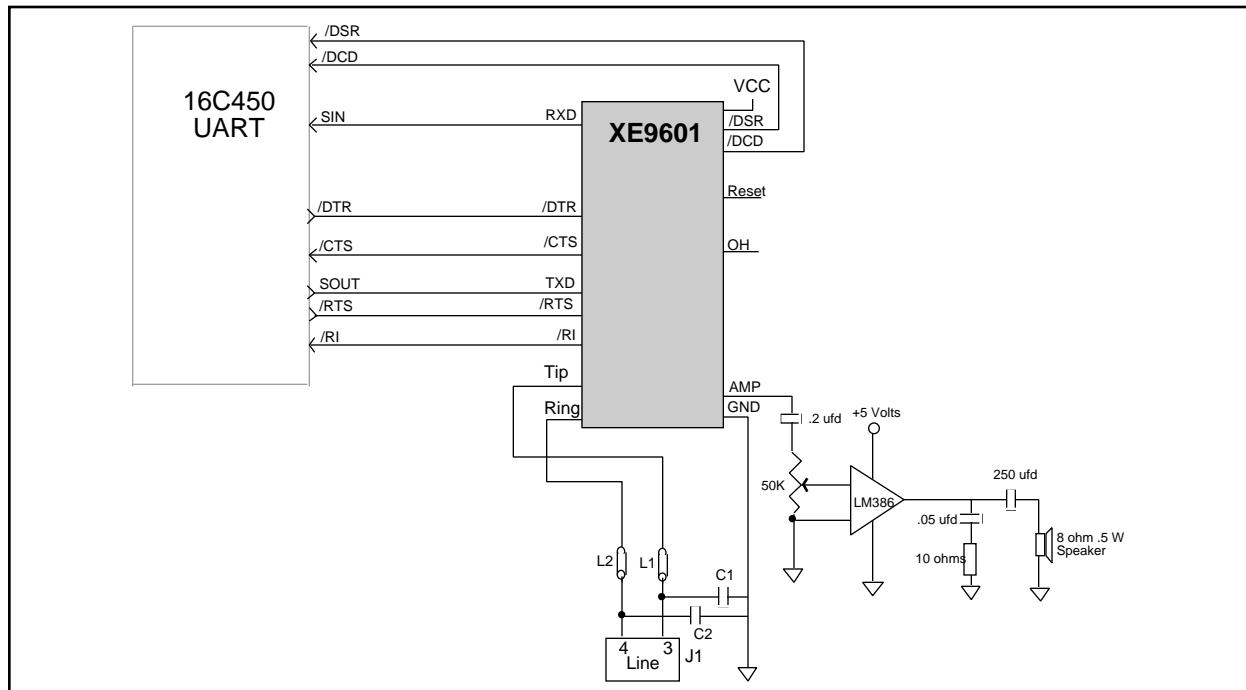
Note: RJ11 Pin assignments reference a 6-pin connector. Tip and Ring are the center pins of all RJ11 jacks.

Recommended Parts

Reference Designation	Description	Recommended Part Number
L1, L2	Ferrite Beads	TDK CB30-1812
C1, C2	Capacitors	Sprague 30GAT47, 470 pfd, 3000 Volts
J1	RJ11 Jack	Stewart SS6446NF

AT Commands

Modes of Operation

The XE9601 has two operating modes; Data mode and Command mode. Modem setup occurs in Command Mode; data transfer occurs in Data Mode.

Data Mode: XE9601 enters data mode after it establishes a modem link and issues the "CONNECT" result code. In Data Mode all signals on Transmit Data (TXD) are sent to the remote modem. Demodulated signals from the remote modem are placed onto Received Data (RXD). The XE9601 exits data mode when it loses the link or receives the escape sequence.

Command Mode: XE9601 enters command mode on power-up, reset, disconnect, or receipt of the escape sequence. The modem accepts commands from the host on TXD and issues Result Codes on RX. The modem ignores signals on TXD which do not conform to the command format.

Command Line Format

Modem commands follow a specified format. Each command begins with the "AT" prefix. The modem stores the command line in its command buffer. The command is executed upon receipt of a carriage return. The command line can be edited up until the time it is executed.

"AT" Prefix - Each command begins with the "AT" prefix. The "A" and "T" may be both upper or lower case but cannot be different cases. The prefix identifies the speed and parity of the host. The modem measures the width of incoming bits to calculate speed and compares the parity bits of the two characters to determine parity.

Command Line - A command line may include a series of commands. Commands are executed in the sequence they appear. A carriage return terminates the command line and triggers the modem to execute the commands. Register S3 allows the user to select a character other than a carriage return to terminate the command line and intitate command execution.

The command buffer holds up to 40 characters including the "AT" prefix. You may insert spaces to improve ledgibility; they do not fill space in the command buffer. If the command buffer overflows, the modem issues an "ERROR" result code, and the commands are not executed.

A Backspace can be used to edit the command line. The command line can only be edited before execution. The backspace erases the previous character in the command line. Register S5 allows the user to select a character other than a backspace to edit the command line.

Re-Execute Last Command - The A/ command causes the modem to re-execute the last command line. This command does not require the "AT" prefix. A command string remains in the command buffer until a new command is issued or power is shut-off.

Ommitted Parameters - Most commands require a parameter to specify the function. When this parameter is omitted from the command, it is assumed to be a 0.

Escape Sequence - An escape sequence switches the modem from data to command mode while maintaining the modem link. The escape sequence uses an escape character, set by Register S2, entered 3 times in succession. The default escape character is "+." A guard timer before and after the sequence prevents normal data from triggering an escape.

Result Codes - The modem issues a result code after each action. Result codes may be full words, numeric codes or may be disabled. Each numeric result code ends with a carriage return. Full word result codes have a Line Feed and Carriage Return before and after the result code. The XE9601 sends result codes at the speed and parity determined from the "AT" prefix.

Result Code Summary

DIGIT	VERBOSE	DESCRIPTION
0	OK	Command executed.
1	CONNECT	Any connection, X0 selected; otherwise connected at 300 bps.
2	RING	Ring signal detected.
3	NO CARRIER	Carrier signal not detected or lost.
4	ERROR	Invalid command line or command buffer overflow.
5	CONNECT 1200	Connection at 1200 bps. Disabled by X0.
6	NO DIAL TONE	No Dialtone detected. Enabled by X2, X4, or W dial modifier.
7	BUSY	Busy detected. Enabled by X3 or X4.
8	NO ANSWER	No silence detected. Enabled by @ dial modifier.
10	CONNECT 2400	Connection at 2400 bps. Disabled by X0.
11	CONNECT 4800	Connection at 4800 bps. Enabled by W0.
12	CONNECT 9600	Connection at 9600 bps. Enabled by W0.

AT Command List

A - Answer Command -

Bn - Select Communications Standard
  n=0 Selects CCITT standards
  n=1 Selects Bell standards*

D - Dial Command -
  P = Pulse dial
  T = Tone dial
  R = Connect as an answering modem
  W = Wait for dial tone
  , = Pause for the duration of S8
  @ = Wait for silence
  ! = Switch hook flash
  ; = Return to the command state

En - Command Echo
  n=0 Do not echo commands
  n=1 Enable command echo*

Fn - Speed Selection
  n=0 Auto detect*
  n=1 300 bps
  n=4 1200 bps
  n=5 2400 bps
  n=6 4800 bps
  n=8 9600 bps

Hn - Switch Hook Control -
  n=0 Switch hook relay opens*
  n=1 The switch hook relay closes

In - Modem Identification

Ln - Speaker Volume -
  n=0 Lowest speaker volume
  n=1 Low speaker volume
  n=2 Moderate speaker volume*
  n=3 High speaker volume

Mn - Speaker Activity -
  n=0 Speaker off
  n=1 Speaker on until carrier received*
  n=2 Speaker remains on
  n=3 Speaker on after dialing until carrier
         is detected.

Nn - Data Rate -
  n=0 Disable Automode Detection
  n=1 Enable Automode Detection *

On - On Line
  n=0 Return On Line with no retrain*
  n=1 Initiate retrain returning On Line.

Qn - Responses
  n=0 Send responses*
  n=1 No Responses

Sr? - Interrogate Register -

Sr=n - Set Register Value -

Vn - Result Codes -
  n=0   Numeric Result Codes
  n=1   English Word Result Codes*

Xn - Result Code Set -
  n=0   Result codes 0 to 4
  n=1   Result codes 0 to 5 and 10
  n=2   Result codes 0 to 6 and 10
  n=3   Result codes 0 to 5, 7 and 10
  n=4   Full Result codes*

Yn - Long Space Disconnect -
  n=0 Long Space Disconnect Disabled*
  n=1 Disconnect on long space

Z - Reset -

AT Command List (continued)

&Cn - DCD Operation
- n=0   DCD is forced active.
- n=1   DCD indicates a valid carrier*

&Dn - DTR
- n=0   DTR is ignored by the modem.
- n=1   Modem switches to command mode when DTR lost.
- n=2   Modem disconnects if host revokes DTR.*
- n=3   The modem performs a soft reset when DTR revoked.

&F - Return to Factory Defaults

&Gn - Guard Tone
- n=0   Guard Tone Disabled*
- n=1   550 Hz Guard Tone
- n=2   1800 Hz Guard Tone

&Ln - Line Type
- n=0   Dial-up Lines*
- n=1   Leased Lines

&Pn - Dial Pulse Make/Break Ratio
- n=0   39/61%*
- n=1   33/67%

&Sn - DSR Operation
- n=0   DSR always active*
- n=1   DSR in accordance with V.25.

&Tn - Test Modes
- n=0   Exit test mode*
- n=1   Local analog loopback
- n=3   Initiate local digital loopback
- n=4   Respond to remote loop request
- n=5   Deny remote loop request
- n=6   Intiate a Remote Digital loopback
- n=7   Remote digital loopback w self-test
- n=8   Local analog loopback w self-test

&V - View Configuration Profile

%En - Automatic Retrain
- n=0   No automatic retrain*
- n=1   Enable automatic retrain break to the host

S-Register Summary

REG.	RANGE/UNITS	DESCRIPTION	DEFAULT
S0	0-255/rings	Number of rings before auto-answer	000
S1	0-255/rings	Count number of incoming rings	000
S2	0-127/ASCII	Escape character	043
S3	0-127/ASCII	Carriage return character	013
S4	0-127/ASCII	Line Feed character	010
S5	0-32,127/ASCII	Backspace character	008
S6	2-255/sec	Dial tone wait time	002
S7	1-60/sec	Wait time for remote carrier	050
S8	0-255/sec	Pause time for comma in command string	002
S9	1-255/0.1 sec	Carrier detect response time	006
S10	1-255/0.1 sec	Delay from loss of carrier to hang up	014
S11	50-255/msec	DTMF dialing speed	095
S12	0-255/0.02 sec	TIES Escape Code Time Limit	050
S18	0-255/sec	Modem test timer	000
S24	0-255/sec	Sleep Mode Activation Timer	000
S25	Bit Mapped	DTR Transitions	005
S30	Bit Mapped	Sleep Mode timer	010
S37	Bit Mapped	Maximum Link Speed	000

Electrical Specifications

ABSOLUTE MAXIMUM RATINGS*	
SUPPLY VOLTAGE - Vcc	+6.5 Volts
DC INPUT VOLTAGE	-0.6 Volts to +6.5 Volts
STORAGE TEMPERATURE RANGE	-25° C TO +85° C
LEAD TEMPERATURE (Soldering, 2 sec per wave)	260° C
OPERATING TEMPERATURE RANGE	0 TO 70° C
*Exceeding these values may result in permanent damage to the device.	

Power Supply Characteristics *(TA = 0 - 70°C, Vcc = 5v ±5%)*

Symbol	Parameter	Typ	Max	Units	Comments
Vcc	Supply Voltage	5.0	5.25	V	
Icc	Vcc Supply Current	200	250	mA	Active State, On Line
		25		mA	Active State, Idle
Iccs	Sleep Current	10.0		mA	Sleep Mode

Power Management: The XE9601 includes an integrated power management capability. If sleep mode is activated, S24, and no activity is detected on the RXD, DTR, or RI the modem will automatically go into a smart sleep mode. In this mode power consumption is typically just 50 milliwatts.

Telephone Line Interface Specifications

PARAMETER	MIN	TYP	MAX	UNIT
Telephone Line Impedance Match		600		ohms
Ring Detect Sensitivity (on hook, Type B ringer)	38			Vrms
Telephone Line Holding Current	0	20	100	mA

I/O Characteristics

Signals	Description		
DIGITAL INPUTS /DTR, /RTS, TXD, RESET	**Input High** min. 2.0 V	**Input Low** max. 0.8 V	
DIGITAL OUTPUTS AR, /RI /CTS, /DSR, /DCD, RXD	**Output High** min. 2.4 V min. 2.4 V	**Output Low** max. 0.8 V max. 0.4 V	**Current Drive** 15 ma 1.6 ma

Other Performance Specifications

PARAMETER		MIN	TYP	MAX	UNIT	COMMENTS
DTMF Level			-2.2	0	dBm	
DTMF Twist (Balance)				3	dB	
DTMF Tone Duration			70		ms	
Pulse Dialing Rate			10		pps	
Pulse Dialing Make/Break			39/61		%	USA
			33/67		%	CCITT
Pulse Interdigit Interval			785		ms	
Billing Delay Interval		2.0			sec.	
Tone Detection Bandpass Frequency		290		665	Hz	3 dB point
Tone Detection OFF to ON Threshold		-33			dBm	into 600 ohms
Tone Detection ON to OFF Threshold		-35			dBm	into 600 ohms
Dial Tone Detect Duration			3.0		sec.	
Ringback Tone Detect	Duration	0.75			sec.	
	Cadence	1.5			sec.	OFF/ON Ratio
Busy Tone Detect	Duration	0.2			sec.	
	Cadence	0.67		1.5	sec.	OFF/ON Ratio

FCC Instructions

This product complies with Part 68 of the FCC Rules. With each device shipped, there is a label which contains, among other information, the FCC Registration Number and Ringer Equivalence Number (REN) for this product. You must, upon request, provide this information to your telephone company.

The mounting of this device in the final assembly must be made in such a manner as to preserve the high voltage protection between the TIP/RING and the rest of the system. Typically, this may be accomplished by maintaining a minimum spacing .100 mils between the TIP/RING Traces to the RJ-11C Jack and low voltage portion of the system. No additional circuitry may be attached between TIP/RING and the telephone line connection, unless specifically allowed in the rules.

The REN helps determine the number of devices you may connect to a telephone line and still have all of these devices ring when the number is called. In most, but not all areas, the sum of the RENs of all devices connected to one line should not exceed five (5.0). To be certain of the number of devices you may connect to the line, as determined by the REN, you should contact the local telephone company to determine the maximum REN for your calling area.

If your system causes harm to the telephone network, the telephone company may discontinue service temporarily. If possible, they will notify you in advance. If advance notification is not practical, you will be notified as soon as possible.

Your telephone company may make changes in its facilities, equipment, operations or procedures that could affect proper functioning of your equipment. If they do, you will be notified in advance to give you an opportunity to maintain uninterrupted telephone service.

If you experience trouble with this device, please contact XECOM at (408) 945-6640 for information on obtaining service or repairs. The telephone company may ask you to disconnect this device from the network until the problem has been corrected or until you are sure that the device is not malfunctioning.

The device may not be used on coin service lines provided by the telephone company (this does not apply to private coin telephone applications which use standard telephone lines). Connection to party lines is subject to state tariffs.

Terms of Sale

Devices sold by XECOM are covered by the warranty provisions appearing in its Terms of Sale only. XECOM makes no warranty, express, statutory, implied, or by description regarding the information set forth herein, or regarding the freedom of the described devices from patent infringement. XECOM makes no warranty of merchantability or fitness for any purposes. XECOM reserves the right to discontinue production and change specifications and prices at any time and without notice. This product is intended for use in normal commercial applications. Applications requiring extended temperature range, unusual environmental requirements, or high reliability applications, such as military, medical life-support or life-sustaining equipment, are specifically not recommended without additional processing and authorization by XECOM for such application.

Xecom assumes no responsibility for the use of any circuitry other than circuitry embodied in a Xecom product. No other circuits, patents, or licenses are implied.

Life Support Policy

Xecom's products are not authorized for use as Critical Components in Life Support Devices or Systems.

Life Support Devices or Systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions provided in the labeling, can be reasonably expected to result in significant injury to the user.

A Critical Component is any component of a life support device or system whose failure to perform can be reasonably expected to cause failure of the life support device or system, or to affect its safety or effectiveness.

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